An Experimental Investigation of Reputation Effects of Disclosure in an Investment / Trust Game[*, **]

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Abstract

This paper examines experimentally the reputation building role of disclosure in an investment / trust game. It provides experimental evidence in support of sequential equilibrium behavior in a finitely repeated investment / trust game where information asymmetry raises the possibility of voluntary disclosure. I define two regimes, namely disclosure regime and no-disclosure regime and it is only in the disclosure regime that such disclosure of private information is a possibility. I compare investment levels across two regimes and find the startling result that investment is lower in disclosure regime. I find that this lower investment is attributable to the fact that the prior probability with which an investor in the disclosure regime believes that a manager is trustworthy is significantly lower than the prior probability with which an investor in the no-disclosure regime believes that a manager is trustworthy. I introduce a two-stage experimental design to homogenize prior beliefs about managers' trustworthiness and find that after such homogenization, investment is higher in disclosure.

Keywords: Disclosure, Reputation, Investment, Trust.

JEL codes: C73, C92, D82, M40.

Data Availability: Contact the author.

1. Introduction

Kenneth Arrow argued that trust is the lubricant of an economy (Arrow (1974)). The importance of trust in our economy and society can hardly be over-emphasized. Attempts to provide economic theory and related tests regarding the role of trust as a lubricant are in their infancy. Underpinnings for deeper aspects of how trust can relate to the vast set of economic institutions that exist in complex economic environments are starting to be explored in laboratory and archival studies of record keeping (Basu and Waymire (2006) and Basu, Dickhaut, Hecht, Towry and Waymire (2009)). This paper focuses on voluntary disclosure and examines experimentally how the opportunity to make voluntary disclosures enhances the building of trust and trustworthiness to facilitate institutions for exchange and investment in complex economic settings where there is separation of ownership and control of key economic resources.

The setting derives from the investment game (Berg, Dickhaut and McCabe (1995)) while incorporating reputation building as discussed in Camerer and Weigelt (1988). In this setting, the investor is endowed with some wealth and chooses how much to invest in a manager. The manager then chooses whether to keep the investment and its earned profit or return some dividend to the investor. The magnitude of the profit depends on the state of nature. The manager always learns the state of nature but the investor may or may not depending upon the regime and upon the manager's decision on whether to disclose voluntarily. There are two regimes, namely disclosure regime and no-disclosure regime. It is only in the disclosure regime that the manager has the option to truthfully disclose the state of nature to the investor.

This paper provides experimental evidence in support of sequential equilibrium play in the above setting. Camerer and Weigelt (1988) argue that sequential "equilibria which rationalize reputation-building are often so complicated that it is reasonable to ask whether people actually play sequential equilibria in naturally-occurring games." While sequential equilibrium theory of reputation building is complicated in and of itself, introducing an additional layer of complexity in the form of asymmetric information and disclosure possibilities raises the question of whether people actually play sequential equilibrium in such a setting. The assumptions underlying the theory are hard to verify in naturally occurring settings and therefore this paper tests the theory in a laboratory setting.

This paper also tests the theoretical prediction that investment is higher in disclosure regime compared to no-disclosure regime. In a setting with two types of managers – trustworthy and rational, choosing to disclose voluntarily and choosing to pay a fair dividend are acts of the trustworthy manager that the rational manager will mimic to receive additional future investments. Theoretically, in a finitely repeated game where disclosure of private information is a possibility (disclosure regime), such mimicry will start with probability 1, and the investor will also invest with probability 1; that is, the game will start with pure strategic play. However, in later periods, mixed-strategy play will start in that the mimicry will switch to occurring with a probability strictly less than 1 to support managerial efforts at reputation building for trustworthiness. This switch will ensure that an investor's prior / ex ante belief about a manager's trustworthiness is updated upward to a point on the threshold at which the investor invests with a probability strictly less than 1.

In contrast, in a finitely repeated game where disclosure of private information is not a possibility (no-disclosure regime), a rational manager will start with paying dividends consistent with the worst possible state of nature. Lack of ex post verifiability of the state of nature implies that she is able to get away with pretending that the worst possible state of nature has occurred; however, this leads to a downward revision of an investor's ex ante belief about a manager's trustworthiness. This downward revision ensures that the mixed-strategy play and the concomitant lower probability of investment will occur sooner in a game where disclosure is not a possibility. These differences in the way managerial reputation building for trust occurs in an economy with disclosure as compared to one without imply that while both economies start with comparable levels of investment, in later periods, investment will be higher in economies with disclosure. Higher investment in later periods in economies with disclosure will translate into higher total investment in such economies.

The hypothesis of higher investment in disclosure regime predicates on equality of prior beliefs across the two regimes. That is, the prior probability with which an investor in the disclosure regime believes that a manager is trustworthy should be equal to the prior probability with which an investor in the no-disclosure regime believes that a manager is trustworthy. In drawing subject samples from the same population, one would not expect the prior beliefs across the disclosure and no-disclosure conditions to be different. However, one very intriguing finding in this paper is that the prior belief in disclosure condition turns out to be lower than the prior belief in no-disclosure condition. This necessitated the homogenization of prior beliefs across the two conditions before one could test the prediction of higher investment in economies with disclosure.

The homogenization of prior beliefs across conditions was achieved via introduction of a two-stage experimental design. The first stage called 'screening round' enabled categorization of subjects as trustworthy and untrustworthy. Then a pre-determined proportion of trustworthy and untrustworthy types were selected to proceed to the second stage called the 'main round'. This proportion was announced to the subjects that proceeded to the main round and provided them an anchor point to form their prior beliefs. The main round comprised either of the disclosure regime or the no-disclosure regime. The screening round while enabling test of the higher investment in disclosure hypothesis is also a methodological contribution.

The rest of the paper proceeds as follows. Section 2 discusses the experiment design and hypotheses. Section 3 discusses the experimental procedures and analyzes the data from disclosure and no-disclosure regimes. Section 4 introduces the screening round, whereas section 5 summarizes and concludes.

2. Experiment Design and Hypotheses

I will define two regimes, namely, a *disclosure regime* and a *no-disclosure regime*. Truthful disclosure of private information is a possibility only in the former regime. Both regimes derive from the investment game of Berg et al. (1995).

2.1 Disclosure Regime – There are two players: a sender/investor and a receiver/manager (hereinafter referred to as investor and manager, respectively). Nature moves first and selects the manager's type as either trustworthy or untrustworthy (to be defined momentarily). The manager

knows her type, but the investor does not. The game then proceeds through three periods, during each of which the investor and the manager make a sequence of choices. In what follows, the subscript t (t = 1, 2, 3) will be used to denote a period. The manager chooses whether to disclose private information she will learn in the course of the game. Note that the manager is not privy to the private information at the time she makes the choice of whether to disclose it—it is information she *will* learn in the course of the game. It is as if the manager is making a choice of the accounting system: the manager could choose an accounting system that will generate information that both the investor and the manager will learn (by choosing to disclose), or alternatively, the manager could choose an accounting system that will generate information only the manager will learn (by choosing not to disclose).

The investor sees the manager's disclosure decision, is endowed with ten units of wealth, and chooses how many of the ten units to send to the manager (denoted by m_t). The manager sees m_t and receives $\lambda_t m_t$. The state of nature or multiplier (denoted by λ) is stochastic in that it is equally likely to be 1, 2, 3, 4, or 5. The manager decides how much of the multiplied amount ($\lambda_t m_t$) to return to the investor (denoted by k_t) and how much to keep for herself ($\lambda_t m_t$ - k_t). The investor receives k_t and learns λ_t only if the manager had earlier chosen to disclose her private information; that is, if the manager had chosen an accounting system that generates information both the investor and the manager learn, then the investor learns λ_t. Otherwise, if the manager had chosen an accounting system that generates information only the manager learns, then the investor does not learn λ_t. In this sense, λ_t is the manager's private information – she always learns the realized value of λ_t, but the investor's knowledge of λ_t is dependent on the manager's choice of the accounting system. The timeline for this game is described in Figure 1.

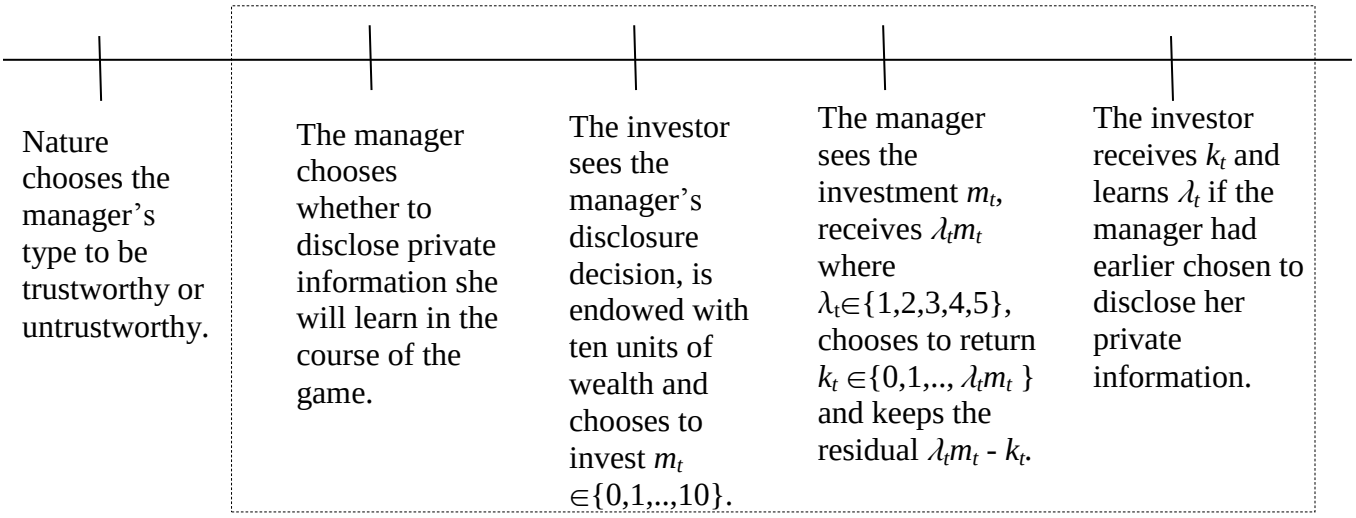
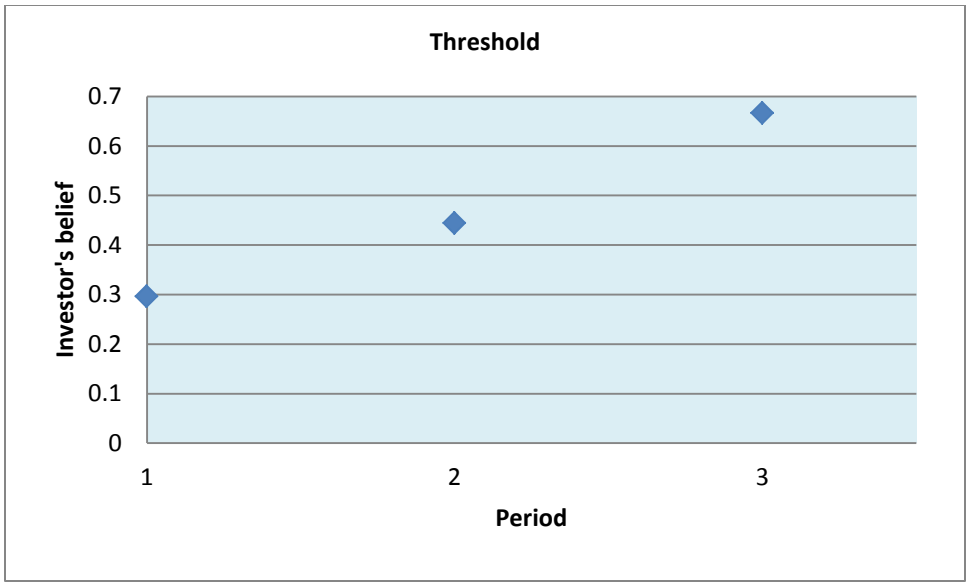


Figure 1 – Timeline of the disclosure regime.

A *trustworthy manager* is defined as one that always chooses to disclose and always chooses to return half of what she receives. An *untrustworthy manager* is defined as a manager that is not trustworthy. The multiplied amount ($\lambda_t m_t$) may be thought of as the gross income of the firm comprising the investor and the manager, and the amount sent back by the manager (k_t) may be thought of as the dividend the manager pays to the investor. Risk neutrality, additively separable utility, and zero discounting rate are assumed.

2.2 Equilibrium in the Disclosure Regime – In equilibrium, the investor plays a threshold strategy and chooses to invest all her endowment of ten units of wealth if her belief about the manager's trustworthiness is above the threshold depicted in Figure 2. If her belief is below the threshold, she chooses to invest nothing.



Period	Threshold	
1	(2/3)^3	0.2963
2	(2/3)^2	0.44444
3	(2/3)	0.66667

Figure 2 – Threshold.

For $t < 3$, the untrustworthy manager mimics the trustworthy type in period t if the investor's period t belief is above the threshold at which she will invest in period $t + 1$. That is, the untrustworthy manager plays a pure strategy of mimicking the trustworthy type with probability 1. However, if the investor's period t belief is below the threshold at which she will invest in period $t + 1$, then the untrustworthy manager plays a mixed strategy. She mimics the trustworthy type with some positive probability strictly less than 1. The choice of the probability is such that the investor's updated period $t + 1$ belief about the manager's trustworthiness is exactly on the threshold.

If the investor's period t belief is exactly equal to the threshold for period t, then the investor is indifferent about how much she chooses to invest. She plays a mixed strategy and chooses to invest a nonzero amount with some positive probability strictly less than 1. The choice of the probability is such that it makes the untrustworthy manager indifferent between mimicking the trustworthy type in period $t - 1$ and not mimicking the trustworthy type in period $t - 1$. In period 3, the untrustworthy manager chooses to disclose if she had chosen $k_2 = \lambda_2 m_2/2$ and then chooses $k_3 = 0$.

Hypothesis 1. The investor and the manager follow the sequential equilibrium strategies in the disclosure regime. An alternative hypothesis is that they follow the sub-game perfect Nash equilibrium strategies in which case there will be no investment and no return in any of the periods.

2.3 No-disclosure Regime – Now consider the same game with the following modification: the investor never learns λ_t; that is, the manager does not have any means available to communicate her private information to the investor, even if she wishes to share this information. A trustworthy manager is defined as one that always chooses $k_t = \lambda_t m_t/2$. This is a setting in which there is a firm comprising an investor and a manager and a gross income of $\lambda_t m_t$,, but there is no accounting system available. A dividend of k_t can still be paid, but the income $\lambda_t m_t$ cannot be reported. The modified timeline is described in Figure 3.

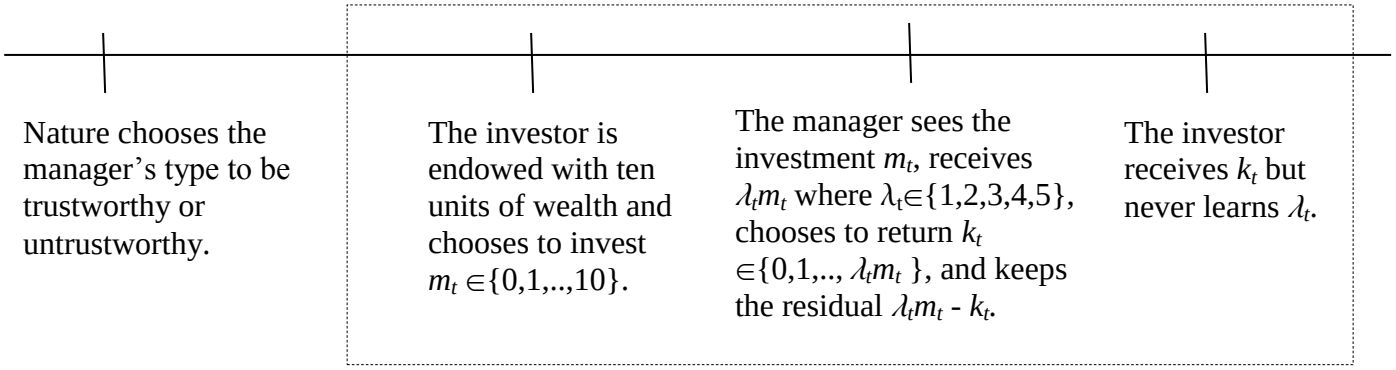


Figure 3 – Timeline of the no-disclosure regime.

2.4 Equilibrium in the No-disclosure Regime – In equilibrium[1], the investor plays a threshold strategy as in the disclosure regime and chooses to invest all of her endowment of 10 units of wealth if her belief about the manager's trustworthiness is above the threshold depicted in figure 2. If her belief is below the threshold, she chooses to invest nothing.

For $t < 3$, if the investor's period t belief is such that her updated period $t + 1$ belief will be above the threshold at which she will invest in period $t + 1$, then the untrustworthy manager plays a pure strategy of returning the minimum amount consistent with her being the trustworthy type. For instance, if $m_1 = 10$ and $\lambda_1 = 4$, then the untrustworthy manager returns $k_1 = 5$. Regardless of what λ_t obtains, the untrustworthy manager will return $k_t = m_t/2$ as long as the investor's updated period $t + 1$ belief will be above the threshold at which she will invest in period $t + 1$. The untrustworthy manager is able to return the minimum amount consistent with her being the trustworthy type because unlike in the disclosure regime, the investor never learns λ_t. Further,

[1] For a derivation of the equilibrium, see Lunawat (2011a) and (2011b).

since the investor knows that the untrustworthy manager returns $k_t = m_t / 2$, she revises her period $t + 1$ belief downwards.

For $t < 3$, if the investor's period t belief is such that untrustworthy manager's returning the lowest amount consistent with her being the trustworthy type will lead to the investor's updated period $t + 1$ belief to be below the threshold at which she will invest in period $t + 1$, then the untrustworthy manager plays a mixed strategy. She returns a non-zero amount with some positive probability strictly less than 1. The choice of the probability is such that the investor's updated period $t + 1$ belief about the manager's trustworthiness is exactly on the threshold.

If the investor's period t belief is exactly equal to the threshold for period t, then the investor is indifferent about how much she chooses to invest. She plays a mixed strategy and chooses to invest a non-zero amount with some positive probability strictly less than 1. The choice of the probability is such that it makes the untrustworthy manager indifferent about how much she chooses to return. In period 3, the untrustworthy manager chooses $k_3 = 0$.

Hypothesis 2. The investor and the manager follow the sequential equilibrium strategies in the no-disclosure regime. An alternative hypothesis is that they follow the sub-game perfect Nash equilibrium strategies in which case there will be no investment and no return in any of the periods.

2.5 Investment in the Disclosure and No-disclosure Regimes – In the no-disclosure regime, if the investor's belief about the manager's trustworthiness is sufficiently high, an untrustworthy

manager can get away with paying a very low dividend. For example, if the investor invests 8 units of wealth and a multiplier of 4 obtains, then the manager receives 32 units of wealth. However, the manager can pay a dividend of only 4 units of wealth and thereby convey to the investor that a multiplier of 1 obtained. Because the multiplier that obtains in not verifiable by the investor, the manager can hide behind a low multiplier. This implies that when the investor sees a dividend that conveys the occurrence of the lowest possible multiplier, she updates her beliefs about manager's trustworthiness in such a way that her posterior belief is lower than her prior belief. Such downward revision of the investor's beliefs in the no-disclosure regime implies that if the game starts in both regimes with the same prior probability, then mixed-strategy play will begin at least as soon in the no-disclosure regime as in the disclosure regime. Under very mild conditions, it can be shown that mixed-strategy play will begin sooner in the no-disclosure regime than in the disclosure regime. In this sense, the disclosure regime provides for additional reputation-building opportunities. Because the probability of investment in a period of pure strategy play is higher than the probability of investment in a period of mixed-strategy play, more pure strategy play in a disclosure regime will translate into higher total investment (m_1 + m_2 + m_3) in a disclosure regime.[2]

Hypothesis 3. Total investment (m_1 + m_2 + m_3) in the disclosure regime is higher than total investment in the no-disclosure regime.

2.6 Experimental Procedures – The experiment was programmed and conducted with the software z-Tree (Fischbacher 2007). The experimental sessions were run at the Center for

[2] For a formal derivation of the proof, refer to Lunawat (2011a) and (2011b).

Interuniversity Research and Analysis on Organizations (CIRANO) in Montreal, Quebec, Canada.

Subjects were assigned the role of an investor or a manager. Roles remained unchanged throughout the session. One investor was grouped with one manager, and the subjects in the group played against each other for a set comprising three periods. At the end of a set, each subject was grouped with some other subject. No two subjects were grouped twice (perfect stranger matching). The roles and the game were explained to the subjects using neutral terminology (e.g. A-player for investor and B-player for manager).

In the disclosure regime, the computer prompted the manager to decide whether she would like to share with the investor the knowledge of the multiplied amount the manager would receive. Then, the investor saw the disclosure decision made by the manager. Note that the no-disclosure regime did not require this stage of the manager's disclosure decision.

The investor was endowed with ten units of experimental currency, called lira. She decided how much of her endowment to send to the manager. The amount sent by the investor was multiplied before the manager received it. The multiplier was equally likely to be 1, 2, 3, 4, or 5. The manager decided on how much to keep and how much to send back to the investor. At the end of every period, the subjects saw their payoffs and relevant information on their respective computer screens. At the end of the experimental session, each subject's total payoff was converted to Canadian dollars using a preannounced exchange rate.

An experimenter read the instructions (similar to the instructions in Appendix A) aloud to the subjects, while the subjects followed along on their own copies of the instructions. After the instructions were read, subjects were asked to answer questions about the experiment. The questions appeared on their computer screens, and they were paid 50 cents for every correct answer. The computerized game started after this quiz. The CIRANO Research Institute in Montreal recruited the subjects. The subject pool at CIRANO draws primarily from students (graduate and undergraduate), although it also includes some nonstudents in Montreal.

3. Evidence on the Sequential Equilibrium Hypotheses

I ran two sessions of the disclosure regime. Sixteen subjects participated in the first session, and 22 subjects participated in the second session. Of the 16 subjects in the first session, 8 were assigned to the role of an investor and 8 to the role of a manager. Perfect stranger matching of investors and managers implied that there were eight sets of three periods each. This session, therefore, yielded 64 (8 sets × 8 investor-manager dyads) observations. Similarly, the second session with 22 subjects yielded 121 (11 sets × 11 investor-manager dyads) observations. Sixty-four observations from the first session and 121 observations from the second session gave a total of 185 observations.

I ran two sessions of the no-disclosure regime. Sixteen subjects participated in the first session, and 24 subjects participated in the second session. As with the sessions on disclosure regime, half of the subjects in each session were assigned the role of an investor and the other half were assigned the role of a manager. Perfect stranger matching was implemented. Therefore, the first session with 16 subjects yielded 64 (8 sets × 8 investor-manager dyads) observations and the

second session with 24 subjects yielded 144 (12 sets × 12 investor-manager dyads) observations. Sixty-four observations from the first session and 144 observations from the second session gave a total number of 208 observations. Descriptive statistics on investment and on average proportion returned in both the regimes / experimental conditions are summarized in Tables 1A and 1B respectively.

Amount Invested by Investor			
Disclosure	Period 1	Period 2	Period 3
Mean	4.79	4.90	4.12
Median	4	4	3
Std Dev	3.66	3.80	3.77
Min	0	0	0
Max	10	10	10
No-disclosure	Period 1	Period 2	Period 3
Mean	6.58	6.26	5.59
Median	7	6.5	6
Std Dev	2.82	3.12	3.62
Min	0	0	0
Max	10	10	10

Table 1A – Summary statistics on investment in disclosure and no-disclosure conditions

Proportion Returned by Manager			
Disclosure	Period 1	Period 2	Period 3
Mean	0.39	0.35	0.16
Median	0.42	0.4	0
Std Dev	0.22	0.2	0.22
Min	0	0	0
Max	1	1	1
No-disclosure	Period 1	Period 2	Period 3
Mean	0.43	0.4	0.3
Median	0.44	0.45	0.35
Std Dev	0.24	0.21	0.24
Min	0	0	0
Max	1	1	1

Table 1B – Summary statistics on proportion returned in disclosure and no-disclosure conditions

3.1 Sequential Equilibrium in the Disclosure Regime – The use of threshold strategy by the investor will show up in 'zero' investments and 'maximum' investments, that is, investments of 0 or 10. In moving from the model to data, it is expected that the threshold strategy will show up in 'low' investments and 'high' investments instead of 'all or zero' investments. Defining 'low' investment as investment of 0 – 3 liras and 'high' investment as investment of 7 – 10 liras,

75.14%, 77.29% and 84.32% of investments in periods 1, 2 and 3 respectively are in the category of 'high or low' investments (Figure 4).

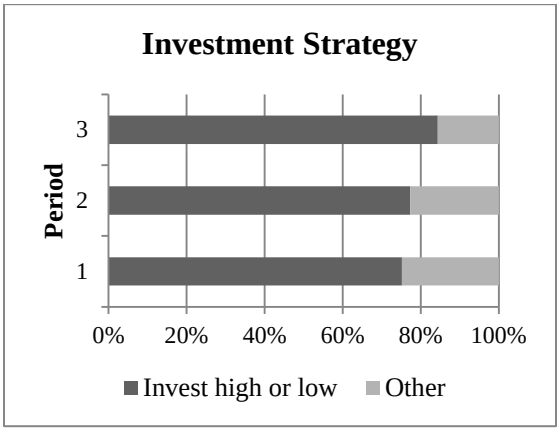


Figure 4 – Investment strategy in disclosure regime

In period 1, the average disclosure is 81.33% (135 / 166). After seeing the manager's disclosure decision, the investor updates her belief about the manager's trustworthiness. The manager's overall return probability (including trustworthy and untrustworthy managers) in period 1 is 0.6641. This overall return probability is estimated from data (Table 2). In estimating the overall return probabilities, instances where a manager returned more than half of what she received have been included with those where she returned half and instances where a manager returned less than half have been included with those where she returned nothing[3]. Since the overall return probability is less than 1, it must be that mixed strategy play by an untrustworthy manager begins in period 1.

	Observed return frequency, from data	Observed return frequency, excluding set 1

[3] In the experiment, a manager was allowed to return only in whole liras. This led to instances where a manager could not return to an investor exactly half of what she received. Consequently, in moving from the model to the data, the cutoff of half or more was replaced by a cutoff of 0.4 or more.

Period 1	0.6454 (91 / 141)	0.6641* (85 / 128)
Period 2	0.7143 (55 / 77)	0.6944 (50 / 72)
Period 3	0.34 (17 / 50)	0.3478 (16 / 46)

Table 2 – Return probabilities

Prior probability, inferred from threshold for period 2 and (*) = 0.2951

Now, the investor sees the manager's return for period 1 and her disclosure decision for period 2. After seeing these, she updates her belief about the manager's trustworthiness. Since mixed strategy play by the untrustworthy manager has begun in period 1, it must be that the investor's updated or posterior belief about the manager's type is exactly equal to the threshold for period 2. The threshold for period 2 is 0.4444 (Figure 2). Using the overall return probability for period 1, the threshold for period 2 and the Bayesian updating formula, one can infer the prior probability at the beginning of period 1. This inferred prior probability is 0.2951.

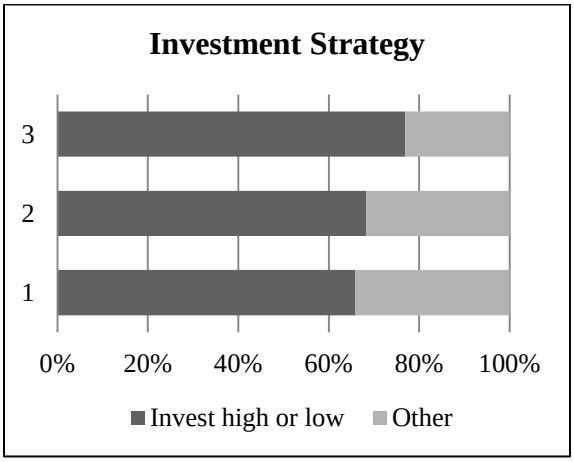
The model predicts that disclosure in periods 2 and 3 will respectively follow return in periods 1 and 2. That is, if the manager returns half or more of what she receives in period 1, then with probability 1 she will disclose in period 2 and similarly if she returns half or more of what she receives in period 2, then with probability 1 she will disclose in period 3. The actual disclosure probability (estimated from data) in periods 2 and 3 is 0.8471 and 0.98 respectively (Table 3). The predicted probability of 1.0 is in the 99% confidence interval for period 3 while it is not in the 99% confidence interval for period 2.

	Predicted	Actual	Excluding set 1	Confidence Interval, 99%
Average disclosure in period 2 given return in period 1[4]	1.0	0.8571 (78 / 91)	0.8471 (72 / 85)	0.7436, 0.9506
Average disclosure in period 3 given return in period 2[5]	1.0	0.9636 (53 / 55)	0.98 (49 / 50)	0.9264, 1.0336

Table 3 – Disclosure given return in previous period

From the evidence presented in this sub-section, it can be concluded that subjects follow the sequential equilibrium strategies described in the disclosure regime. They do not follow the sub-game perfect Nash equilibrium strategies.

3.2 Sequential Equilibrium in the No-disclosure Regime – Defining 'low' investment as investment of 0 – 3 liras and 'high' investment as investment of 7 – 10 liras, 65.87%, 68.27% and 76.92% of investments in periods 1, 2 and 3 respectively are in the category of 'high or low' investments (Figure 5).



[4] This is average disclosure in period 2 given disclosure in period 1 *and* non-zero investment in period 1 *and* return in period 1.
[5] This is average investment in period 3 given disclosure in period 1 *and* non-zero investment in period 1 *and* return in period 1 *and* disclosure in period 2 *and* non-zero investment in period 2 *and* return in period 2.

Figure 5 – Investment strategy in no-disclosure regime

Table 4[6] shows the manager's overall return probability (including trustworthy and untrustworthy managers). This overall return probability is estimated from data. In estimating the overall return probabilities, instances where a manager returned more than half of what the investor invested were included with instances where she returned exactly half and instances where a manager returned less than half were included with instances where she returned nothing[7]. Note that while in the disclosure regime, the cutoff used is half or more of what the manager received, in the no-disclosure regime, the cutoff used is half or more of what the investor invested. This is because in the no-disclosure regime, an untrustworthy manager can return the minimum amount consistent with her being the trustworthy type while in the disclosure regime such return behavior is disciplined by the presence of an accounting disclosure system.

	Observed return frequency, from data (2)	Observed return frequency, excluding Set 1 (3)
Period 1	0.8607 (173 / 201)	0.8674* (157 / 181)
Period 2	0.9353 (159 / 170)	0.9416 (145 / 154)
Period 3	0.5 (74 / 148)	0.5 (67 / 134)

Table 4 – Return probabilities

[6] There are no instances in the data where investment did not occur in period t but occurred in period (t+1) or period(s) subsequent to (t+1).

[7] In the experiment, a manager was allowed to return only in whole liras. This led to instances where a manager could not return to an investor exactly half of what the investor invested. Consequently, in moving from the model to the data, the cutoff of half or more of what the investor invested was replaced by a cutoff of 0.4 or more of what the investor invested.

Prior Probability, inferred from threshold for period 2 and (*) = 0.3855

The manager's overall return probability (including trustworthy and untrustworthy managers) in period 1 is 0.8674 (Table 4). Since there are some instances of zero return, it must be that mixed strategy play by an untrustworthy manager begins in period 1. Now, the investor sees the manager's return for period 1 and updates her belief about the manager's trustworthiness. Since mixed strategy play by the manager has begun in period 1, it must be that the investor's updated or posterior belief about the manager's type is exactly equal to the threshold for period 2. The threshold for period 2 is 0.4444 (Figure 2). Using the overall return probability for period 1, the threshold for period 2 and the Bayesian updating formula, one can infer the prior probability at the beginning of period 1. This inferred prior probability is 0.3855.

From the evidence presented so far in this sub-section, it can be concluded that subjects follow the sequential equilibrium strategies described in the no-disclosure regime. They do not follow the sub-game perfect Nash equilibrium strategies.

4. Evidence on Higher Investment in Disclosure Hypothesis

Average investment in the disclosure regime turns out to be lower than average investment in the no-disclosure regime in each of the three periods (Tables 1A and 1B). Table 5 reports the repeated-measures ANOVA for the effect the option to disclose (which is available only in the disclosure regime) has on total investment ($m_1 + m_2 + m_3$). It reiterates the significant difference between investment in the disclosure regime and investment in the no-disclosure regime.

Source	Partial SS	df	MS	*F*	Prob > *F*
Model	26431.06	73	362.07	15.9	0
Option to disclose	2351.21	1	2351.21	103.28	0
Subject | option to disclose	4404.03	37	119.03	5.23	0
Group | option to disclose	22321.71	35	637.76	28.02	0
Residual	7261.99	319	22.76		
Total	**33693.04**	**392**	**85.95**		

Table 5 – ANOVA[8] for the effect of option to disclose on total investment

4.1 Differences in Priors as a Possible Explanation for Lower Investment in Disclosure – Lower investment is disclosure is a startling result. It seems attributable to the differences in prior beliefs across the two regimes. The prior probability with which an investor in the disclosure regime believes that a manager is trustworthy is lower than the prior probability with which an investor in the no-disclosure regime believes that a manager is trustworthy. This prior probability in the disclosure regime is 0.2951, whereas this prior probability in the no-disclosure regime is 0.3855 (Tables 2 and 4).

Further, 17 managers in period 3 of the disclosure regime were trustworthy (Table 6A), whereas 74 managers in period 3 of the no-disclosure regime were trustworthy (Table 6B). This implies that in the disclosure regime, at least 9.19 percent (17/185) of the initial sample of 185 observations was composed of trustworthy managers (Table 6A), whereas in the no-disclosure regime, at least 35.58 percent (74/208) of the initial sample of 208 observations was composed of trustworthy managers (Table 6B).

[8]In Tables 5A – 5C and Tables 8A – 8C, I have treated Group as the repeated. Alternatively it is possible to treat Subject as the repeated variable – it will lead to qualitatively similar results.

	All sets	Excluding Set 1
Number of observations	185	166
Number of observations where disclosure occurred in period 1 (1)	149	135
Number of observations from (1) where nonzero investments occurred in period 1 (2)	141	128
Number of observations from (2) where manager returned half or more of what she received in period 1 (3)	91	85
Number of observations from (3) with disclosure in period 2 (4)	78	72
Number of observations from (4) where nonzero investments occurred in period 2 (5)	77	72
Number of observations from (5) where manager returned half or more of what she received in period 2 (6)	55	50
Number of observations from (6) with disclosure in period 3 (7)	53	49
Number of observations from (7) where nonzero investments occurred in period 3 (8)	50	46
Number of observations from (8) where manager returned half of what she received in period 3 (9)	17	16
Proportion of trustworthy types in the original sample is at least	9.19% (17/185)	9.64% (16/166)

Table 6A – Summarizing the data collected for the disclosure regime

	All sets	Excluding Set 1
Number of observations (1)	208	188
Number of observations from (1) where nonzero investments occurred in period 1 (2)	201	181
Number of observations from (2) where manager returned an amount consistent with her being the trustworthy type in period 1 (3)	173	157
Number of observations from (3) where nonzero investments occurred in period 2 (4)	170	154
Number of observations from (4) where manager returned an amount consistent with her being the trustworthy type in period 2 (5)	159	145
Number of observations from (5) where nonzero investments occurred in period 3 (6)	148	134
Number of observations from (6) where manager returned half of what she received in period 3 (7)	74	67
Proportion of trustworthy types in the original sample is at least	35.58% (74/208)	35.64% (67/188)

Table 6B – Summarizing the data collected for the no-disclosure regime

The subject samples for both the disclosure and the no-disclosure regimes are drawn from the same population, and it is very intriguing that the prior beliefs across the samples are different. It may also be that the disclosure regime induces a lower prior belief than the no-disclosure regime. Though the question of why the disclosure regime induces a lower prior belief is in and of itself interesting, the next section introduces an experimental design to homogenize prior beliefs across the disclosure and no-disclosure regime samples. Because the prediction of higher investment in the disclosure regime is for a case of equal prior beliefs, such homogenization will enable a test of the prediction.

4.2 Screening Round – A two-stage design was introduced to ensure that prior beliefs across the disclosure and no-disclosure samples were equal. The first stage was called the screening round and enabled the classification of managers into trustworthy and untrustworthy types. Then, a predetermined proportion of trustworthy and untrustworthy managers proceeded to the second stage, called the main round. This proportion was announced to the subjects who proceeded to the main round to give them an anchor point for forming their beliefs. The main round comprised either the disclosure regime or the no-disclosure regime. Common anchor points for subjects participating in the post-screening disclosure regime and the post-screening no-disclosure regime ensured that prior beliefs in the two post-screening regimes were equal. The screening round comprised a simplified version of the one-shot investment game. This simplified version is derived from McCabe and Smith (2000) and is graphed in Figure 6.

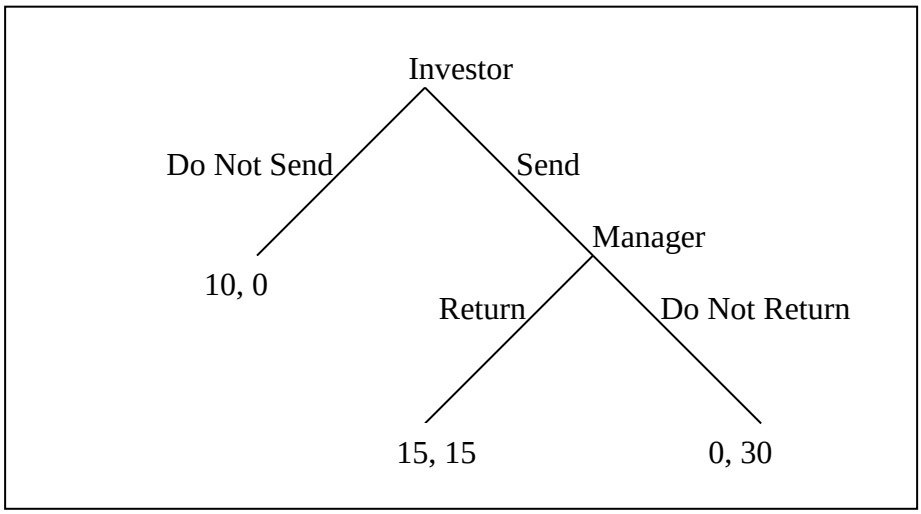


Figure 6 – Screening round.

An experimenter read aloud the instructions for the screening round (attached in Appendix B) to the subjects, while the subjects followed along on their own copies of the instructions. The subjects were recruited for three hours. Therefore, after reading the instructions for the screening round, they had the potential to be able to guess that there was something more to follow. Such guessing could alter their behavior in the screening round. To preempt this, the instructions said, "After everyone finishes this game on the computer, all of you will proceed to another session." Now, creating a required mix of managers meant that not all subjects who participated in the screening round could go to the main round. Therefore the subjects who did not go to the computerized main round filled out a questionnaire for $10.

I ran 2 sessions – the main round comprised the disclosure regime in the first session and it comprised the no-disclosure regime in the second session. Twenty-six subjects participated in the screening round of the first session. Of these, 13 were assigned to the role of an investor and 13 were assigned to the role of a manager. The roles and the game were explained to the players

using neutral terminology (e.g. A-player for investor and B-player for manager). Of the 13 investors, 2 did not invest and consequently, the 2 managers they were respectively paired with could not be categorized into trustworthy or untrustworthy. Of the remaining 11 managers, 8 returned and were classified as trustworthy while 3 did not return and were classified as untrustworthy. Thirty subjects participated in the screening round of the second session – 15 were assigned to the role of an investor and 15 were assigned to the role of a manager. Of the 15 investors, 5 did not invest leaving only 10 managers in the game. Of these 10 managers, 7 returned and were classified as trustworthy while 3 did not return and were classified as untrustworthy.

In each of the two sessions, 3 untrustworthy managers and 1 trustworthy manager were selected to go to the main round. This proportion was announced to the participants of the main round in the instructions for the main round (Appendix A). Further, in each session, any 4 of the subjects who played the role of an investor in the screening round were randomly selected to go the main round. Of these 8 subjects (4 investors and 4 managers) that proceeded to the main round in each session, those who were assigned the role of an investor in the screening round continued to play as an investor in the main round, and those who were assigned the role of a manager in the screening round continued to play as a manager in the main round. One investor was grouped with one manager, and the subjects in the group played against each other for three periods. At the end of three periods, each subject was grouped with some other subject. No two subjects were grouped twice (perfect stranger matching). Eight subjects in the main round and implementation of perfect stranger matching implies that there were 16 observations for each

experimental session. Descriptive statistics on investment and on average proportion returned in both the conditions are summarized in Tables 7A and 7B respectively.

Amount Invested by Investor			
Disclosure	Period 1	Period 2	Period 3
Mean	7.5	7.69	7.38
Median	7	7	7
Std Dev	2	1.99	2.66
Min	4	5	2
Max	10	10	10
No-disclosure	Period 1	Period 2	Period 3
Mean	4.38	5.19	3.75
Median	4	4	2.5
Std Dev	3.46	3.62	3.64
Min	0	0	0
Max	10	10	10

Table 7A – Summary statistics for investment in post-screening disclosure and no-disclosure conditions

Proportion Returned by Manager			
Disclosure	Period 1	Period 2	Period 3
Mean	0.4	0.35	0.11
Median	0.41	0.38	0
Std Dev	0.15	0.2	0.15
Min	0.08	0	0
Max	0.67	0.7	0.4
No-disclosure	Period 1	Period 2	Period 3
Mean	0.33	0.25	0.13
Median	0.29	0.23	0
Std Dev	0.32	0.22	0.23
Min	0	0	0
Max	1	0.67	0.75

Table 7B – Summary statistics for proportion returned in post-screening disclosure and no-disclosure conditions

Table 8 reports the repeated-measures ANOVA for the effect the option to disclose (which is available only in the disclosure regime) has on total investment ($m_1 + m_2 + m_3$). The total investment is significantly higher in the disclosure regime, confirming hypothesis 3.

Source	Partial SS	df	MS	*F*	Prob > *F*
Model	1485.75	13	114.29	4.74	0.001
Option to disclose	684.5	1	684.5	28.38	0.00
Subject | option to disclose	188.88	6	31.48	1.31	0.3
Group | option to disclose	612.38	6	102.06	4.23	0.01
Residual	434.13	18	24.12		
Total	**1919.88**	**31**	**61.93**		

Table 8 – ANOVA for the effect of option to disclose on total investment in the post-screening sessions

The mimicking and end game behavior by untrustworthy managers in the post-screening disclosure and no-disclosure conditions is reported in tables 9A and 9B respectively.

	All sets
Number of observations	16
Number of observations where disclosure occurred in period 1 (1)	7
Number of observations from (1) where nonzero investments occurred in period 1 (2)	7
Number of observations from (2) where manager returned half or more of what she received in period 1 (3)	5
Number of observations from (3) with disclosure in period 2 (4)	5
Number of observations from (4) where nonzero investments occurred in period 2 (5)	5
Number of observations from (5) where manager returned half or more of what she received in period 2 (6)	4
Number of observations from (6) with disclosure in period 3 (7)	2
Number of observations from (7) where nonzero investments occurred in period 3 (8)	2
Number of observations from (8) where manager returned half of what she received in period 3 (9)	0
Proportion of trustworthy types in the original sample is at least	0

Table 9A – Summarizing the data collected for the post-screening disclosure regime

	All sets
Number of observations (1)	16
Number of observations from (1) where nonzero investments occurred in period 1 (2)	14
Number of observations from (2) where manager returned an amount consistent with her being the trustworthy type in period 1 (3)	11
Number of observations from (3) where nonzero investments occurred in period 2 (4)	10
Number of observations from (4) where manager returned an amount consistent with her being the trustworthy type in period 2 (5)	10
Number of observations from (5) where nonzero investments occurred in period 3 (6)	8
Number of observations from (6) where manager returned half of what she received in period 3 (7)	2
Proportion of trustworthy types in the original sample is at least	12.5% (2/16)

Table 9B – Summarizing the data collected for the post-screening no-disclosure regime

4.3 Other Possible Explanations for Lower Investment in Disclosure – One possibility is that the actual disclosure per se, as against the option to disclose, has an effect on investment. In both set of experiments, average investment in each of the three periods is higher when actual disclosure occurred than the average investment respectively in each of the three periods when actual disclosure did not occur. However, in the first set of experiments, the average investment in each of the three periods when disclosure occurred in disclosure condition is still lower than the average investment respectively in each of the three periods in no-disclosure condition. And, in the second set of experiments, the average investment in each of the three periods when disclosure did not occur in disclosure condition is still higher than the average investment respectively in each of the three periods in no-disclosure condition.

I ran the repeated-measures ANOVA for the effect the actual disclosure in period 1 of the disclosure regime has on the investment for that period in the first set and in the second set of experiments. While the actual disclosure does not have any significant effect on the investment in period 1 in the second set of experiments, it does have a significant effect on the investment in the first period of the first set of experiments. I ran the repeated-measures ANOVA for the effect the actual disclosure in periods 2 and 3 of the disclosure regime has on the investment for the respective periods in both the first set and the second set of experiments. Actual disclosure did not have a significant effect on investment in any of these. To fully tease out the effect of actual disclosure versus the effect of option to disclose will require future research. A possible research design involves collecting additional data for a regime where mandatory disclosure of information is required. Then, one can run a regression of investment on actual disclosure and on the option to disclose.

Another possibility is that the existence of an institution undermines trust. In this case, it is the existence of the institution of disclosure which per se undermines trust and might possibly be the key driving beliefs to be unequal. A related paper that suggests that knowledge of existence of institutions, including contracts, undermines trust is Malhotra and Murnighan, 2002. But there is no unanimity among academics that institutional structures undermine trust. For example, Coletti, Sedatole and Towry (2005) show that a strong institutional structure can actually engender trust. Future research will be needed to address the issue of whether disclosure undermines trust in an investment / trust game.

5. Conclusion

This paper illustrates the potential for the construct of voluntary disclosure to promote reputation building and welfare-increasing investment in an exchange with private information. Reputation building occurs differently in a regime where disclosure of private information is a possibility (disclosure regime) as compared to one where such disclosure is not a possibility (no-disclosure regime). Without disclosure, a dividend is the only tool available for reputation building. There is no way to identify untrustworthy behavior with certainty, so the value of benevolent behavior is diminished. In contrast, disclosure allows honest versus dishonest behavior to be distinguished, thereby making benevolent behavior more valuable. This differential reputation building is confirmed by experimental data, thereby establishing the model as a good predictor of behavior. Controlling for heterogeneous beliefs about player trustworthiness, I also find that the opportunity to make truthful voluntary disclosure raises the level of investment, improving the overall welfare of both parties.

While shedding light on the role of disclosure in trust environments, this paper also makes some methodological contributions. Existing research on accounting institutions uses accounting history to motivate hypotheses which are then tested experimentally. This study introduces a theoretical perspective in analyzing the role of accounting institutions. The use of the simplified version of one-shot investment game for a screening round is a contribution to experimental methodology.

There are several interesting extensions possible to the setting examined in this paper. One possibility is to define a regime with mandatory disclosure and then compare the effect of mandatory versus voluntary disclosure regimes on trust, reputation and investment. Another possibility is to introduce a multiplier of zero in the set of possible multipliers and examine the role of bankruptcy in trust settings. It is possible to introduce reinvestment of the 'income of the firm' in this setting. The reinvestment will allow definition of balance sheets and thus, an examination of the differential role of income statements and balance sheets in building trust in economic exchange. Given that Historical Cost Accounting is income statement driven while Fair Value Accounting is balance sheet driven, such an examination could potentially shed light on the differential role these two accounting regimes play in facilitating trust and stimulating investment in an economy.

The focus of this paper is the reputation building role of voluntary disclosure. Therefore, this paper has abstracted away from the possibility of differences in managerial talent and the possibility of a disclosure decision after a manager sees her private information. However,

disclosure has been argued to be a managerial talent signaling device and an unanswered question for future research then is the role reputation building may play where managers have different abilities in that a better manager has a higher probability of obtaining a higher multiplier. Further, letting a manager make a disclosure decision after she sees her private information will allow examining how the information content of disclosure interacts with strategic reputation building in trust settings.

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Appendix A: Instructions for Main Round

Instructions

Introduction

You have been invited to participate in a decision making experiment. This experiment will last approximately two hours. During today's session, you will earn income in an experimental currency called Lira. At the end of the session, this currency will be converted to dollars at a rate of $0.08 (8 cents) per Lira, and you will be paid in cash. In addition to this income, you will also receive a show-up fee of $10.

Please read these instructions very carefully. You will be required to complete a quiz, in order to demonstrate that you have a complete and accurate understanding of these instructions. After you have completed the quiz, the administrator will check your answers and discuss with you any questions that have been answered incorrectly.

You are free to withdraw from the experiment at any time, for any reason. If you choose to do so, please raise your hand. In this case, you will be paid your $10 show-up fee as you leave.

Session Overview

This session will be run entirely over the computer. Please do not talk with any of the other participants. If you have a question, you may raise your hand, and the administrator will answer the question privately.

Roles and Procedures

Every participant will be assigned to the role of either an A-player or a B-player. Once assigned, your role will remain unchanged during this session. Note that if you were assigned the role of an A-player in the previous game, you will be an A-player in this session, too and similarly, if you were assigned the role of a B-player in the previous game, you will be a B-player in this session, too. Also, of every 4 B-players playing this session, 1 B-player returned to the A-player while 3 B-players did not return to the A-player in the previous game. Now, you will know your own role, but you will not know the role of any other participant. You will play several sequences of 3 periods each. In the beginning of every 3-period sequence an A-player and a B-player will be grouped for that sequence. No 2 participants will be grouped twice.

Each period proceeds through four stages. The 4 stages are briefly described in Figure 1.

Outline of the Stages in Each Period

Stage 1 - B-player decides whether or not private information (multiplied amount) s/he will get in stage 3 will get revealed to A-player in Stage 4.

Stage 2 - A-player sees the decision made by B-player and receives an endowment of 10 liras (experimental currency unit). A-player then decides how many of the 10 liras to send to B-player.

Stage 3 - The amount sent by the A-player is multiplied. This multiplied amount is received by the B-player. B-player then decides how much of the multiplied amount to return to A-player and how much to keep for himself / herself.

Stage 4 - A and B-players are told their payoffs and relevant information.

Figure1

Stage 1 **– B-Players' Disclosure Decisions**

In Stage 1, B-player will have the choice of deciding whether s/he wants to let the A-player know the multiplied amount s/he will receive from A. B-player will see the following screen:

Screen 1

B-player may click either 'Yes' or 'No'.

Stage 2 – **A-Players' Decisions**

A-player sees the decision made in Stage 1 by the B-player s/he is paired with. A-player also receives an endowment of 10 Liras. In the second stage, A-player will be prompted by the computer to decide how much of the initial endowment to keep and how much to send to a paired B-player. The amount sent will always be in whole Lira. The A-player will keep any money s/he has not sent to B-player.

A-player will see the following screen:

Screen 2

Stage 3 – **B-Players' Decisions**

The amount sent by the A-player is multiplied by 1 or 2 or 3 or 4 or 5 (referred to as 'the multiplier') before the B-player receives it. B-player will see the following screen (namely, Screen 3). Please note that every multiplier is equally likely to occur.

Screen 3

B-player decides how much of the total amount to return to A-player. The amount returned will always be in whole Lira. B-player will keep the amount s/he does not send back to A-player.

The B-player's Stage 3 decisions will be entered on Screen 3, pictured above.

Stage 4 - **Disclosure and Payoffs**

In each period, A-player's payoff will be the sum of the amount that s/he did not send to B-player and the amount returned by B-player. In each period, B-player's payoff will be the amount that s/he received minus the amount s/he returned to A-player.

Following each period, A-player will receive the information presented on Screen 4, pictured below. Note that A-player will learn the amount B-player received only if B-player has elected to let the A-player know this amount.

Screen 4

Following each period, B-player will receive the information presented on Screen 5, pictured below.

Screen 5

Completion of Periods

After completing each period, the computer will proceed to the next period, which will be conducted identically to the previous period. After every 3 periods, every A-player will be grouped with a different B-player and every B-player will be grouped with a different A-player. You will not be grouped with the same participant twice.

Once all periods have been completed, you will be paid your cumulative income.

Please answer the questions that appear on your screen. You will be paid 50 cents for every correct answer. The experiment will begin after all the participants have answered all the questions.

The following questions appeared on subjects' screen. Answers are provided next to the questions.

1. How many B-players will each A-player be grouped with in each sequence of 3 periods? **1 B-player**

2. How many liras will an A-player be endowed with in Stage 2 of each period? **10 liras**

3. No two participants will be grouped more than once (True / False). **True**

4. Will the amount sent by an A-player to a B-player be multiplied en route before it reaches the B-player (Yes / No)? **Yes**

5. Suppose A-player sent 1 lira. What are the possible amounts B-player may receive? **1, 2, 3, 4, 5**

6. Is each multiplier equally likely in each round? **Yes**

7. Suppose in a period A-player sent to B-player 6 liras and then received from B 10 liras. What will be player A-player's profit from the pairing with B?
   Amount retained by A + Amount returned by B = 4 + 10 = 14 liras

8. Suppose in a period A-player sent 3 liras to B-player. B-player received 9 liras and sent back 2 liras to A-player. What will be B-player's profit from pairing with A?
   Amount received by B – Amount returned by B = 9 – 2 = 7 liras

Appendix B: Instructions for Screening Round

Instructions

Introduction

You have been invited to participate in a decision making experiment. I will read these instructions out loud. Please do not talk among yourselves. If you have any questions, please raise your hand. I will then answer your questions individually.

During today's session, you will earn income in an experimental currency called Lira. At the end of the session, this currency will be converted to dollars at a rate of $1 per Lira, and you will be paid in cash. In addition to this income, you will also receive a show-up fee of $10. You are free to withdraw from the experiment at any time, for any reason. If you choose to do so, please raise your hand. In this case, you will be paid your $10 show-up fee as you leave.

Session Overview

Every participant will be assigned to the role of either an A-player or a B-player. Every A-player will be endowed with 10 liras. A-player can choose to send his / her endowment to a paired B-player. If the A-player chooses not to send the endowment, then the game ends here – B-player receives nothing from A and A-player keeps her / his endowment of 10 liras. If A-player chooses to send her / his endowment to the B-player, then the endowment is tripled before it reaches the B-player. That is, the B-player receives 30 liras.

If the B-player receives 30 liras from A-player, s/he can choose to return to the A-player. If B-player chooses to return, then A-player receives 15 liras and B-player keeps 15 liras. If B-player chooses not to return, then A-player receives nothing and B-player keeps 30 liras.

Figure 1 summarizes the game.

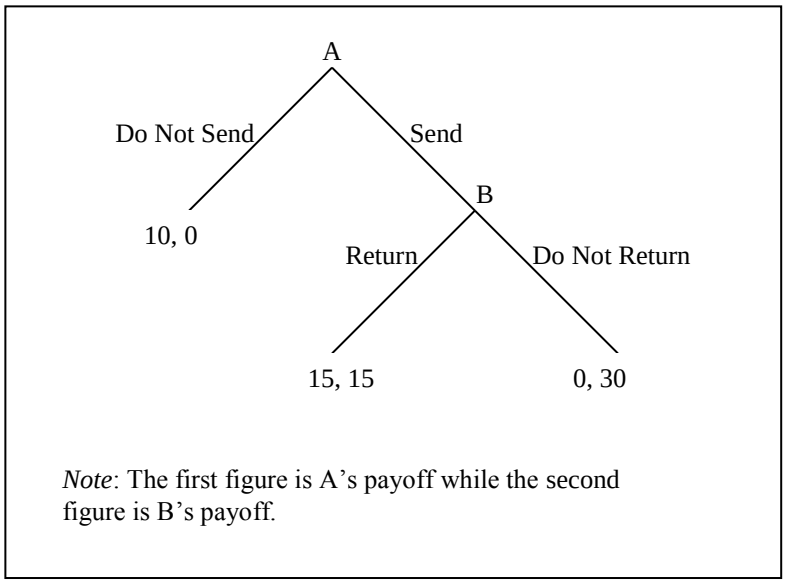

Figure 1

After everyone finishes this game on the computer, all will proceed to another session.